

Appl. No. 10/537,350
Amendment dated: December 1, 2008
Reply to OA of: August 29, 2008

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This listing of claims will replace all prior versions and listings of claims in the application.

Listing of Claims:

Claims 1-61(canceled).

62(currently amended). A reactor for solid phase continuous polymerisation of polyethylene terephthalate (PET), comprising:

a casing;

a feeding line to feed a low molecular weight PET pre-polymers flow into said reactor;

a gas line to feed, through supply valves, a gas into said reactor;

a discharging line inferiorly connected to the bottom of the reactor to discharge the polymerised product;

a circuit connected to the reactor to purify the gas and to recover pre-polymer particles by means of a proper separator;

wherein, said casing of said reactor is horizontally arranged; and

wherein, inside said reactor, means are provided to generate a plurality of fluidised stages in series to cause an increase of the intrinsic viscosity (I.V.) of said PET pre-polymers flow; and

wherein in correspondence with each fluidised stage a sufficient gas flow is generated by said supply valves, each valve being equipped with a heating device,

wherein said I.V. increase of said PET pre-polymers flow is ≥ 0.06 dl/g.

63(previously presented). The reactor according to claim 62, wherein said casing of said reactor has a substantially parallelepiped shape.

64(previously presented). The reactor according to claim 63, wherein said

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means comprise a plurality of inferior vertical walls secured to the base of said reactor and a plurality of superior vertical walls secured to the ceiling of said reactor, said fluidised stages being generated between said inferior walls.

Claims 65-72(canceled).

73(previously presented). The reactor according to claim 62, wherein said fluidised stages in series are five in number.

74(previously presented). The reactor according to claim 62, wherein said feeding line is equipped with a device suitable for regulating the flow-rate of fed amorphous PET pre-polymer and to prevent gas leakage.

75(previously presented). The reactor according to claim 74, wherein said device is a rotating volumetric distributing apparatus.

76(previously presented). The reactor according to claim 62, wherein said discharging line is equipped with a device suitable for discharging the PET after solid phase polymerisation and to prevent gas leakage.

77(previously presented). The reactor according to claim 76, wherein said device is a rotating volumetric distributing apparatus.

78(previously presented). The reactor according to claim 62, wherein said circuit further comprises a separation device to recover ethylene glycol and oligomers at the liquid state and then to recycle them upstream of the overall PET manufacturing cycle.

79(previously presented). The reactor according to claim 62, wherein said PET pre-polymers flow has a low initial I.V. value, generally an I.V. value in the range of 0.20 - 0.45 dl/g.

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80(previously presented). The reactor according to claim 62, wherein said I.V. increase of said PET pre-polymers flow is in the range of 0.35 – 0.65 dl/g.

81(canceled).

82(currently amended). The reactor according to claim [[81]] 62, wherein said I.V. increase of said PET pre-polymers flow is ≥ 0.20 dl/g.

83(previously presented). The reactor according to claim 62, wherein said PET pre-polymers flow is a PET sand flow, the sand particle size preferably being in the range 60 – 300 μm .

84(previously presented). The reactor according to claim 83, wherein said PET pre-polymers flow is a PET sand flow, the sand particle size preferably being in the range 100 – 250 μm .

85(previously presented). The reactor according to claim 62, wherein said PET pre-polymers flow fed into the reactor is maintained in said reactor at a temperature in the range 200 – 235°C.

86(previously presented). The reactor according to claim 85, wherein said PET pre-polymers flow fed into the reactor is maintained in said reactor at a temperature in the range 205 – 230°C.

87(previously presented). The reactor according to claim 62, wherein said gas is an inert gas.

88(previously presented). The reactor according to claim 62, wherein said gas flow inside said reactor is directed in cross-flow or in counter-current flow with respect to the flow of the PET granules that pass through said reactor.

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89(previously presented). The reactor according to claim 62, wherein the ratio between the mass of the gas flow that passes through said reactor and the mass of the PET granules in the reactor is > 0.62 .

90(previously presented). The reactor according to claim 89, wherein the ratio between the mass of the gas flow that passes through said reactor and the mass of the PET granules in the reactor is > 0.9 .

91(previously presented). The reactor according to claim 62, wherein said gas is an inert gas or air.

92(previously presented). The reactor according to claim 91, wherein said gas is air with a dew point $< -30^{\circ}\text{C}$.

93(previously presented). The reactor according to claim 91, wherein said gas is a mixture of gases selected from the group consisting of nitrogen, noble gases, carbon dioxide, carbon monoxide and oxygen, and wherein the oxygen content is $< 10\%$ by weight.

94(previously presented). The reactor according to claim 91, wherein said gas is a mixture of gases selected from the group consisting of nitrogen, noble gases, carbon dioxide, carbon monoxide and oxygen, and wherein the oxygen content is $< 6\%$ by weight.

95(previously presented). The reactor according to claim 62, wherein the gas is recycled to the reactor, after having been purified of the organic impurities, until a level of organic impurities ≤ 100 p.p.m. by weight (CH_4 equivalent) has been reached.

96(previously presented). The reactor according to claim 62, wherein the PET granules have an irregular shape with a volume comprised between 0.05 and 10 mm^3 .

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97(previously presented). The reactor according to claim 62, wherein inside said reactor the polyester granules are subjected to a solid phase polycondensation and/or drying and/or crystallisation and/or dealdehydisation.

98(currently amended). A process for solid phase continuous polymerisation of polyethylene terephthalate (PET), comprising the steps of:

feeding a low molecular weight PET pre-polymers flow into a horizontally arranged reactor through a feeding line;

feeding a gas into said reactor through a gas line in cross-flow or in counter-current flow with respect to said PET pre-polymers flow,

carrying out said polymerisation in a plurality of fluidised stages in series generated inside said reactor to cause an increase of the intrinsic viscosity (I.V.) of ≥ 0.06 dl/g of said PET pre-polymers flow, and

bringing at the desired temperature the gas flowing through supply valves, each valve being associated to a fluidised stage and being equipped with a heating device.

99(previously presented). The process according to claim 98, wherein said polymerisation is carried out in a number of fluidised stages in series of five.

100(previously presented). The process according to claim 99, wherein said polymerisation is carried out at non-isothermal conditions.

101(previously presented). The process according to claim 99, wherein said polymerisation is carried out at isothermal conditions.

102(previously presented). The process according to claim 99, wherein said polymerisation is carried out in a time period of about 2 hours.

103(previously presented). The process according to claim 98, wherein said PET pre-polymers flow has a low initial I.V. value, generally an I.V. value in the range of 0.20 - 0.45 dl/g.

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104(previously presented). The process according to claim 98, wherein said I.V. increase of said PET pre-polymers flow is in the range of 0.35 – 0.65 dl/g.

105(canceled).

106(previously presented). The process according to claim 105, wherein said I.V. increase of said PET pre-polymers flow is ≥ 0.20 dl/g.

107(previously presented). The process according to claim 98, wherein said PET pre-polymers flow is a PET sand flow, the sand particle size being in the range 60 – 300 μm .

108(previously presented). The process according to claim 107, wherein said PET pre-polymers flow is a PET sand flow, the sand particle size being in the range 100 – 250 μm .

109(previously presented). The process according to claim 98, wherein said PET pre-polymers flow fed into the reactor is maintained in said reactor at a temperature in the range 200 – 235°C.

110(previously presented). The process according to claim 109, wherein said PET pre-polymers flow fed into the reactor is maintained in said reactor at a temperature in the range 205 – 230°C.

111(previously presented). The process according to claim 98, wherein said gas is an inert gas.

112(previously presented). The process according to claim 98, wherein said gas flow inside said reactor is directed in cross-flow or in counter-current flow with respect to the flow of said PET granules that pass through said reactor.

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113(previously presented). The process according to claim 98, wherein the ratio between the mass of the gas flow that passes through the reactor and the mass of the PET granules in the reactor is > 0.62 .

114(previously presented). The process according to claim 113, wherein the ratio between the mass of the gas flow that passes through the reactor and the mass of the PET granules in the reactor is > 0.9 .

115(previously presented). The process according to claim 98, wherein said gas is an inert gas or air.

116(previously presented). The process according to claim 115, wherein said gas is air with a dew point $< -30^{\circ}\text{C}$.

117(previously presented). The process according to claim 115, wherein said gas is a mixture of gases selected from the group consisting of nitrogen, noble gases, carbon dioxide, carbon monoxide and oxygen, and wherein the oxygen content is $< 10\%$ by weight.

118(previously presented). The process according to claim 115, wherein said gas is a mixture of gases selected from the group consisting of nitrogen, noble gases, carbon dioxide, carbon monoxide and oxygen, and wherein the oxygen content is $< 6\%$ by weight.

119(previously presented). The process according to claim 98, wherein the gas is recycled to the reactor, after having been purified of the organic impurities, until a level of organic impurities ≤ 100 p.p.m. by weight (CH_4 equivalent) has been reached.

120(previously presented). The process according to claim 98, wherein the PET granules have an irregular shape with a volume comprised between 0.05 and 10 mm^3 .

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121(previously presented). The process according to claim 98, wherein inside said reactor the polyester granules are subjected to one or more processes selected from the group consisting of solid phase polycondensation, drying, crystallisation and dealdehydisation.

122(previously presented). The process according to claim 98, wherein ethylene glycol and oligomers present at the end of said polymerisation are recovered at the liquid state in a separation device provided in a circuit connected to the reactor and then recycled upstream of the overall PET manufacturing cycle.